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RADIOLOGICAL WEAPONS OF TERROR

by

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Contents

Abstract

Recent Presidential speeches have highlighted the threat posed by chemical and biological terrorism. But what about the first leg of the Nuclear, Biological and Chemical (NBC) triad? This paper examines the potential threat to US interests from radiological weapons of terror, including both nuclear weapons, and radiological dispersion devices (RDDs), devices that intentionally use radiation to harm. There are four main factors that increase the risk of nuclear and radiological terrorism to US vital interests: first, technical knowledge is more readily available due to the Internet. Second, there has been a marked increase in source availability with the economic collapse of Russia. Third, security procedures are extremely lax, employing demoralized workers and utilizing grossly inadequate procedures. Finally, despite a decrease in the overall number of terrorist incidents, these attacks are becoming more lethal. These four factors taken together strongly suggest that it is only a matter of time before a nuclear or a radiological terrorist attack is levied against a vital US interest.

But what if an attack occurs? Consequences of a radiological and nuclear terrorist attack are contemplated. Finally, countermeasures are discussed including both preventive and consequence management actions. The paper concludes that a radiological terrorist attack will probably occur in the future and offers some recommendations for dealing with this eventuality.

Chapter 1

Background

Weapons of mass destruction pose the greatest potential threat to global stability and security.

— *National Security Strategy*, October 1998[1]

Introduction

As combat commanders lead the application of the military instrument of power in support of the national security strategy, they face an ever-increasing variety of threats in the environment. Operation Desert Storm showed that the United States (US) could dominate in a conventional war scenario, a demonstration of symmetrical warfare. But recent history shows that US interests are more likely to be attacked via asymmetrical war; that is isolated acts of violence (vice general war) such as attacks from non-state actors, such as terrorists. Are terrorist attacks becoming more lethal and would terrorists be willing and able to employ weapons of mass destruction? This paper explores these issues in detail.

Weapons of mass destruction (WMD) include nuclear/radiological, biological, and chemical weapons, or NBC weapons for short. Chemical and biological weapons have received a great deal of media attention in the last three years. President Clinton, in his 22 January 1999 speech before the National Academy of Sciences, called for $1.46

billion in additional funding to counter threats posed by chemical and biological attacks. Only once did he mention the word "nuclear" in his speech and failed to even mention the word "radiological." Within the Department of Defense, the Marine Corps stood up its Chemical and Biological Incident Response Force (CBIRF), a task force that is dedicated to Consequence Management of potential chemical or biological attacks.[2] Consequence Management is the set of response actions taken in the event of a disaster response, including any type of terrorist attack. But what of nuclear or radiological attacks? The Joint Chiefs of Staff are requesting that the threat to US interests, including US Forces be assessed from radiological weapons of terror.[3]

Thesis

This leads to our research question: Is there a credible threat to US interests from a radiological weapon of terror? The overwhelming evidence indicates that there is a credible threat to the US interests, including US forces, from these weapons.

Terms

There are two general types of radiological weapons: a nuclear weapon and a radiological dispersion weapon. Nuclear weapons release vast amounts of energy through an uncontrolled fission or fusion nuclear reaction, resulting in a release of massive amounts of energy, often measured in terms of tens, thousands or even millions of tons (kilotons or megatons) of TNT (trinitrotoluene). "Fusion weapons are far more destructive than fission weapons, but can only be produced by technologically advanced states, at great cost."[4] As a by-product of a nuclear explosion, large quantities of ionizing radiation are released, and this radiation is potentially lethal to bystanders. Images of

Hiroshima and Nagasaki come to mind. This paper will use the term improvised nuclear device (IND) to refer to a nuclear weapon. These INDs could be either manufactured by terrorist groups, stolen from states, or be used by a state actor. A radiological dispersion weapon or device (RDW or RDD) is a weapon intentionally designed to use or distribute radioactive material to cause a harmful effect on something or someone. The term RDD will be used to indicate this type of device. The type of radioactive materials that could be used varies widely, and could even utilize fissionable material such as plutonium and or uranium. This type of weapon can have a wide range of effects from creating a panic situation based on the fear of radiation, a general denial of territory due to contamination, the murder of a specific individual or individuals, to creating a mass casualty situation.

Overview

Our intent of this paper is not to discuss the health effects of such a threat; these are covered eloquently elsewhere.[5] The goal of this paper is to examine if there is a threat from radiological weapons of terror, and if so, what countermeasures can be taken against it.

In this paper we will examine the different types of INDs and RDDs that could be manufactured, purchased, or stolen and employed by a state or non-state actor. We will also examine IND and RDD deployment methods. In order to build one of these devices, a sufficient amount of appropriate radiological or nuclear source material must be obtained. We examine the methods of obtaining such material. Next, we will examine aspects of terrorist actions including trends and activities of both state and non-state actors. Finally, we will discuss possible consequences and available countermeasures against radiological weapons of terror.

Notes

[1] National Security Strategy, p. 6

[2] CBIRF Families, "CBIRF Families Home Page." 7 Mar. 1999. http://www.geocities.com/Pentagon/Quarters/7778/welcome.html (7 Mar. 1999)

[3] Air University. "Research Topics, CJCS." 18 Aug. 1998. http://www.au.af.mil/(18 Aug 1998)

[4] Falkenrath, Richard A. "Confronting Nuclear, Biological and Chemical Terrorism." *Survival*, Vol. 40, Autumn 1998, p. 45

[5] Cohen, David. "United States Air Force Expeditionary Forces Vol. 3: Appendix I" United States Air Force Scientific Advisory Board, Chapter 8, pp. I-125 - I-133

Chapter 2

Threat Assessment

I could build a fifteen-kiloton bomb—certainly powerful enough to kill a million people in the middle of Manhattan

Ted Taylor, one of the chief designers at Los Alamos National Laboratories[1]

Descriptions, Types and Delivery Methods

INDs – In order to fabricate a nuclear weapon, the builder must have an adequate amount of suitable, fissionable radioactive material, normally either Plutonium-239 (Pu-239) or Uranium-235 (U-235), along with a suitable detonation device. Uranium is a naturally occurring element, with the vast majority, about 99.3%, being in the form of non-fissionable U-238, and only about 0.7 % existing in the form of fissionable U-235.[2] In order for it to be used in a weapon, the U-235 content must be increased by a process known as enrichment. The product, weapons grade U-235, is often referred to as highly enriched uranium (HEU). Depending upon the efficiency of the triggering mechanism, approximately three to twenty five kilograms of HEU are needed to create a nuclear weapon, or between one to eight kilograms of Pu-239.[3] Richard Falkenrath, a faculty member of the John F. Kennedy School of Government at Harvard University reports, "the main technical barrier to nuclear-weapons acquisition is access to a sufficient quantity of fissile material, either plutonium or as highly enriched uranium." [4]

Once appropriate source material is obtained the weapon can be triggered in two ways, either an implosion, which requires precision timing and explosives, or a gun-type assembly of two sub-critical masses of fissionable material. A gun-type assembly is less efficient although much easier to construct. In summary, a nuclear weapon can be constructed provided the manufacturer has sufficient quantities of weapons grade materials, an appropriate detonation device, and the required level of technical expertise.

Delivery methods for INDs range widely, based on the size of the device, the type of target, and the specific constraints of the mission. If the target were a concentration of military personnel, such as a military base or barracks, an attacker might choose a vehicular-mounted IND, similar in principle to the conventional bombings at Khobar towers, or the federal building in Oklahoma City. If the target were smaller, or to foil security measures, the attacker could utilize a briefcase-sized IND which could be smuggled into a building or other target.[5] Finally, an IND could be deployed in more exotic ways, from an aircraft, ranging from an ultralight to an intercontinental bomber, to a wide variety of boats, to mounting it on a missile such as an Iraqi Scud. A state or state-sponsored actor might be more likely to employ the weapon using a high-tech method such as a missile, whereas a non-state actor would be more likely to use a less sophisticated method of employment such as a motor vehicle or even a person.

RDDs – An RDD, on the other hand, can be used to fulfil a wide variety of purposes and assume a number of different forms. It could consist of simply hiding a sealed radioactive source in an unsuspected place. A Russian Mafia group used this exact technique to murder an individual.[6] Another technique is to embed radioactive material in a bomb with conventional explosives. Iraq manufactured bombs that were armed with

radioactive material for its war against Iran.[7] The purpose of these weapons, although they never were used, was to disperse radioactive materials, and thus contaminating the battlefield.[8] In the authors' opinion, other types of RDDs could be constructed using a nitrogen fertilizer and diesel fuel bomb, similar to what was used in Oklahoma City, lacing it with radioactive materials. If the builders' intent of this was to kill as many people as possible, then the choice of radioactive material might be spent fuel rods from a nuclear power plant. Spent fuel rods are highly radioactive and have the capacity to inflict lethal radiation doses. On the other hand, if the objective was to cause mass panic the radioactive material source could be something more benign, such as Depleted Uranium (DU), which is naturally occurring uranium that has had the U-235 removed. Due to its extreme density, DU is commonly used in armor and armor-piercing shells.

The radiation effects of a large RDD can be duplicated by attacking a nuclear or radiological facility in either a conventional or unconventional manner. An example of this is attacking a factory that produces common radiopharmaceuticals such as Technicium-99. Another example would be to attack a commercial nuclear power plant. In both these examples the attacker would attempt to cause effects ranging from panic and mild contamination on one end of the spectrum to death on a massive scale at the other.

Delivery methods for RDDs are basically the same as with the IND discussed above with two additions; first the RDD employer could use an aerosol generator, either fixed or mobile (automobile, boat, or airborne mounted). Aerosol generation would probably not get the appropriate radiological concentration needed to cause lethal effects; however, great psychological effects could be created using this technique. Second, the RDD

employer could also introduce a dissolvable solid or liquid radioactive material into a water supply. The result would most likely be very similar to an aerosol generator, i.e. a non-lethal, but panic-inducing effect. Therefore, these two delivery methods for RDDs could make an excellent adversarial PSYOPS weapons.

In summary, the technology for fabricating an RDD is extremely basic; all one needs is a source of radioactive materials. But where would a terrorist obtain these materials?

Availability of Source Material

> *Ironically, in the post-cold war world, one of the safest places for plutonium may well be on top of a missile.*
>
> -Phil Williams[9]

With the end of the Cold War and the collapse of the Soviet Union, a new and potentially dangerous source of nuclear and radiological materials exists. The recent economic woes in the Former Soviet Union (FSU) have caused a cascading effect leading to a vast degradation in security at nuclear and radiological facilities, including poor inventory procedures and disgruntled workers, which in turn has lead to a sharp increase in theft. Let us begin by looking at security concerns.

Security

> *Security technologies in some automobiles are more effective than those in many nuclear weapons.*
>
> -John Nuckolls[10]

The security situation at Russia's nuclear and radiological facilities is grave. The collapse of the central control systems in Russia has left previously secure facilities and material vulnerable to theft, seizure, or loss.[11] US experts say not one of the 90 facilities, where nearly 700 tons of weapons-grade materials are stored, has adequate security.[12]

Warheads from the Cold War are being dismantled at an accelerated pace. Russia is dismantling 80% of its nuclear arsenal, creating hundreds of tons of HEU, which is being stored at scattered, insecure sites across the country, and is being guarded by workers who might not have been paid in months.[13] Under START II, Russia will reduce its arsenal from 10,000 nuclear weapons to 3,500.[14] So far the excess warheads are being removed and stored intact.[15] Altogether Russia has about 40,000 warheads to secure.[16]

US experts say Russian nuclear security is so weak that the entire dismantling operation should be shut down until the security issue can be resolved.[17] For example, at Building 116 of the Kurckatov Institute in the Moscow suburbs, about 73 kilograms of HEU are stored in high school-type lockers and are secured only by a single chain looped through the handles.[18] Another example of poor security is at the Chelyabinsk-65 installation, where bulk plutonium is stored there in an old warehouse that has glass windows and a padlock on the door.[19]

One of the most common anti-theft tools in the nuclear industry is a radiation portal monitor. These monitors detect radioactive materials entering or leaving a facility and sound an alarm. In fact, radiation portal monitor technology is so available, that many junkyards in the US have them to detect any radioactive materials coming into the facility. In stark contrast 80% of nuclear facilities in Russia do not have radiation portal monitors.[20]

Not only is the physical security poor at Russian facilities, but there is no systematic security approach to the industry as a whole.[21] There are over 100 separate facilities in Russia that are producing weapons-grade materials.[22] No comprehensive baseline inventories of nuclear and radioactive source materials exist, therefore the exact

magnitude of the problem is not known.[23] Oleg Bukharin, a research staff member at Princeton University's Center for Energy and Environmental Studies, sums up the whole situation by saying that source material in Russia is not secure and that it presents a decommissioning nightmare. So far the US has spent $590 million, but Russia needs billions to solve its security problems.[24] Delays in securing excess nuclear weapons make nuclear source material more available than at any other time in history, presenting a most urgent threat.

Information

The Internet is revolutionizing the availability and dissemination of information. A potential terrorist simply needs a modem and a computer to have access to information that may aid in helping him to build an IND or an RDD. Plans and designs for nuclear weapons can be found on the Internet.[25] As a specific example, the Manhatten project of the 1940s has been declassified and workable designs are on the Internet.[26] Thus a terrorist now has easy access to design information. He now needs only the appropriate source materials and some technical knowledge to construct a weapon.

Theft

> *Trade in uranium and plutonium during the past five years has given smuggling unprecedented relevance to international security.*
>
> Phil Williams[27]

Smuggling and theft of radiological material is on the rise.

> According to a report by Russian intelligence in early 1993, there have been about 150 incidents over the years in which terrorist organizations have attempted to steal fissionable material, attack and damage nuclear research facilities, and murder or kidnap officials or scientists dealing with atomic research and development.[28]

German authorities reported 41 nuclear-material smuggling incidents in 1991 and 267 incidents in 1994.[29] The following is a brief summary of just a few incidents that have been reported in the open literature. In November 1993 a thief used a hacksaw to cut off a padlock on a storage compartment at the Sevmorput shipyard near Murmansk, and made off with parts for three nuclear fuel assemblies, each containing 4.5 kilograms of HEU.[30] German police arrested a businessman for possession of 6 grams of Pu-239. In Prague, in the Czech Republic, police arrested three men who had 2.7 kilograms of HEU stashed in their car. Two of the men were nuclear workers and the third was an unemployed Czech physicist.[31] In 1992 an unknown thief, or thieves, stole 1.7 kilograms of 90%-pure HEU from the Luch Scientific Production Association in Russia.[32] In yet another incident, six kilograms of HEU were found on Russian soldiers in the Ukraine.[33]

Not only fissile material itself presents a potential hazard, but also entire nuclear weapons themselves are missing. Russian General Alexander Lebed recently announced that during a routine inventory, 84 Special Atomic Demolition Weapons were found missing from Russian arsenals.[34] These weapons comprise but a small number of the 17,000 tactical nuclear weapons that are known to exist in Russia.[35] Also a wealthy investor could sponsor salvage operations on four Russian submarines which are known to have sunk with both nuclear weapons and their reactor cores still aboard. The easiest one of these submarines to conduct potential salvage operations on is sitting at a depth of 3,650 meters (about 12,000 feet) in the Norwegian Sea. This sub contains two warheads with 6 Kg of Plutonium each as well as a reactor core containing 116 Kg of HEU.[36]

In terms of radiological theft, in October 1993 Istanbul police seized 2.5 kilograms of U-238.[37] A Pole died as the result of exposure to radiation from a Cesium source that

he stole and kept in his pocket. A butcher in St Petersburg kept Uranium in a pickle jar in his refrigerator.[38] The abandoned radon industrial complex in Grozny serves as an example of how easy it is for a thief to steal radiological material for RDDs. The facility is unguarded and secured only by a single padlock, yet the facility contains over 1500 Curies of radioactive waste material.[39] The Curie is a unit of measure of radioactivity.

Once a thief has possession of radiological or nuclear material stolen from Russia, it is a simple task to cross the relatively permeable southern borders into Armenia, Azerbaijan, Kazakstan and Turkmenistan. This is supported by the testimony of Jessica Stern, who formerly directed Russian, Ukranian and Eurasian affairs for the National Security Council.[40]

Other potential sources of radiological material, which could potentially be stolen, include materials used in medical and industrial applications, particularly radioteletherapy sources used in medical treatment such as Cesium-137 or Cobalt-60. The 1987 Goiania, Brazil incident demonstrates this. Four people were killed from acute radiation exposures and many more were injured when someone found an abandoned radiotherapy Cesium source containing 1400 Curies, and broke it open, contaminating a large area.[41] In addition industrial radiography sources, used to inspect welds in pipes in field work, use mainly a strong Iridium–192 source.[42] These are just a small sampling of the types of radiological materials available, which could potentially be stolen and used in an RDD.

In summary, radiological and nuclear materials are readily available, can easily be stolen due to lax security procedures in the FSU, and finally, can easily be smuggled out of the FSU.

How Great is the Threat?

The popular press highlighted concern over nuclear terrorism in 1995 when *Time* magazine put a picture of a skinless face holding a glowing sphere in its teeth with the caption “Nuclear Terror for Sale.” Since that time some of the events that prompted that particular story, and others like it, have been reconsidered. The *Time* magazine article described multiple seizures of smuggled fissionable material. In each case German officials arrested the suspects in sting operations in which East Europeans were asked by supposed customers to provide the lethal material.[43]

Another event that same year hightened popular press coverage of the WMD terrorist threat. That event was the Aum Shinri Kyo cult’s use of a Weapon of Mass Destruction (WMD), Sarin nerve gas, in the Tokyo subway tunnels. Their attack killed 12 and wounded 5,500.[44] That incident highlighted the fact that terrorists are able to obtain, develop and employ relatively sophisticated WMD. Is this type of activity a precursor to attacks against the US with radiological weapons? What are the trends? Who would employ such weapons and what steps has the US taken to prevent their employment?

Trends

US policy recognizes the danger posed by radiological weapons. The October 1998 *National Security Strategy* identifies a WMD threat to US interest under the heading of both “transnational threats” and “spread of dangerous technologies.”[45] The agency most responsible for preventing terrorist acts against the US, the Federal Bureau of Investigation (FBI) supports the contention that WMD are a significant threat to US interests.

According to FBI director Louis Freeh, while terrorist incidents have decreased in frequency they increased in lethality.[46] That assertion is supported by the US State Department's April 1998 report on terrorism. The report shows that over the ten years from 1988 to 1997 international terrorist incidents decreased approximately fifty percent.[47]

That same report lists casualties from anti-US terrorist incidents in the years 1992-1997. The average yearly casualty figures more than tripled in those seven years.[48] If one adds the deaths caused by two incidents in 1998, the attacks on two US Embassies in Africa, the yearly average casualty figure increases to 14 fatalities per year resulting from anti-US terrorism.[49]

This increase in lethality has been accompanied by a tripling in the number of WMD-related threats the FBI responded to between 1996 and 1997.[50] This combination of fewer but more deadly attacks, and the increased number of threats involving the use of WMD, may indicate an increased likelihood of the use of radiological weapons in order for hostile actors to achieve maximum lethality.

According to authors Donald Snow and Dennis Drew, an actor must have both the ability and the will to wage war.[51] If one considers terrorism as war conducted by non-traditional means then there are multiple actors who probably have, or are pursuing the means (ability) and have demonstrated intent (will). Who could potentially use radiological weapons against the US?

Actors

To understand the threat posed to US interests by radiological weapons one should understand the actors who might employ these weapons. For the purposes of this paper

the actors will be put into three camps: states, state-sponsored terrorists, and non state-sponsored terrorists.[52]

State

State actors include those nations that possess nuclear material. Some lack capable long-range delivery means such as intercontinental ballistic missiles and might employ a smaller man- or vehicle-portable, radiological weapon in lieu of more expensive technologies. These states may also choose to use a radiological dispersion weapon that does not involve the level of sophistication needed to produce a fission-fusion weapon. Also states that do have stand-off delivery means may find it in their interest to have a radiological weapon employed via an individual as a lone agent in order to avoid clear attribution to their country.

State Actors and Ability. States unfriendly to the US that possess, or are actively seeking the materials to construct radiological weapons include Iran, Iraq, Libya and North Korea.[53] Additionally, states who host terrorists become de facto targets of our efforts to stop nuclear terrorism. Sudan is one example of a host country attacked to stop WMD development. In that country a commercially owned pharmaceutical plant suspected of producing biological agents was damaged in attacks in April 1998 intended to hurt the terrorist Osama bin Laden.[54] Any states possessing, and most of those pursing nuclear weapons are candidates for production of radiological weapons. The technology required to produce a "dirty bomb" or RDD is much less sophisticated than that required to produce a nuclear bomb. Rogue states that are not considered nuclear powers can easily develop radiologically enhanced weapons. In the 1980s during the Iran-Iraq war, Iraq developed and successfully tested aircraft-delivered bombs filled with radioactive

material for use on the battlefield.[55] Though these weapons were not used in combat they were viable even though Iraq was not considered a nuclear power. As described in the technology section previously, any nuclear-capable state can produce the technically less sophisticated radiologically enhanced weapons, to include the RDDs discussed in this paper. Given this ability, are there state actors with the will to employ these weapons?

State and Will. According to the USAF Scientific Advisory Board on the Air Expeditionary Force, Iraq may have chosen not to use radiation weapons against Iran because they perceived the targeted Iranians and their leaders were "immune" to the fear these weapons were intended to generate.[56] This would probably not be the case in the US. Are there other reasons a hostile state actor might choose not to employ radiological devices? A possible deterrent the US could employ may be a stated national policy of retaliation directly against state leadership for use of WMD. Prior to the Gulf War, intelligence analysts predicted that Iraq would use WMD (specifically chemical) against coalition forces.[57] Iraq did not; why? Possibly because the Presidential Decision Directive (PDD) promulgated prior to the ejection of Iraq from Kuwait specifically threatened the Iraqi leadership if they conducted attacks with, or supported terrorist using, WMD.

> Should Iraq resort to using chemical, biological, or nuclear weapons, be found supporting terrorist acts against U.S. or coalition partners anywhere in the world, or destroy Kuwait's oil fields, it shall become an explicit objective of the United States to replace the current leadership of Iraq. I also want to preserve the option of authorizing additional punitive actions against Iraq. [58]

In both instances national will of the actor was a critical element. In the Iran-Iraq War, Iraq appeared willing to use radiological weapons but probably chose not to because Iran was not psychologically vulnerable to the fear and panic these weapons could

produce. The Iraqi RDD had limited utility possibly because of the prevailing ignorance and minimal detection capabilty of the targeted battlefield population. During the Gulf War, Iraq possessed the ability but not the will to employ such weapons probably due to the anticipated coalition response. As a nation, the US believes that at least one state actor, Iraq, if permitted the ability to assemble WMD, possesses the will to employ them and therefore should suffer repeated military strikes. The strikes against Iraq in December 1998 (Operation Desert Fox) included suspected WMD targets.[59]

State-Sponsored and Non State-Sponsored Actors Terrorists/Actors

The use of INDs or the threat of their use is a tool available to both state-sponsored and non state-sponsored terrorists on the world stage. Thirty-three separate terrorist organizations are identified in the State Department's annual report on Patterns of Global Terrorism. Thirteen, or slightly more than a third of the groups are identified as having some form of state sponsorship. The other 20 may receive support from expatriate communities but no formal support links have been identified between these terrorist organizations and any recognized state.[60] The organizations profiled by the State Department vary widely in size from less than ten members to tens of thousands of members.[61]

State-Sponsored Actors

What does state sponsorship mean? According to the State Department it means supporting "international terrorism either by engaging in terrorist activity themselves or by providing arms, training, safe haven, diplomatic facilities, financial backing, logistic and/or other support to terrorists."[62]

According to the US State Department, Cuba, Iran, Iraq, Libya, North Korea, Sudan and Syria are all state sponsors of terrorism.[63] The reason these states sponsor terrorism is that they each consider terrorism a tool of their foreign policy.[64]

The notion of using terrorism as a tool of the state was codified in the Former Soviet Union as part of broad spectrum of political conflict. Their term for this activity was "active measures."[65] If terrorism is an "active measure" in some states' foreign policy, what ability exists for those states to employ radiological weapons through terrorist surrogates against the US?

State-Sponsored Ability. The ability to employ radiological weapons for state-sponsored terrorists is directly tied to the ability of their sponsors to obtain and configure such materials. Conversely, if a state-sponsored terrorist group acquires the means or materials to produce radiological weapons the sponsoring state will most likely also gain access to that capability.

Fears of nuclear terrorism increased in 1993, after the World Trade Center bombing, when the FBI investigated an alleged plot by Iranians to smuggle nuclear material into Manhattan and distribute it around the city.[66] Had this plot been confirmed, and the actors sponsored by Iran, this clearly would have been a state-sponsored actor employing nuclear or radiological weapons.

In 1994 Congressional research implicated Iran and Syria as producers of high-quality counterfeit US currency that was used to purchase nuclear-related materials. The intermediaries for laundering this money were identified as terrorist groups controlled by both countries. Those same groups formed connections with organized crime, especially in the FSU, to obtain nuclear-related materials.[67] Since these state-controlled terrorist

organizations are key players in the sponsoring nation's weapon acquisition process, it is possible these same terrorists could make use of the material and information they are asked to obtain for their own purposes.

Karl-Heinz Kamp of the Konrad Adenauer Institute in Germany takes a different view. He believes that a state sponsor is not likely to provide expertise and materials to a terrorist organization that it sponsors. The sponsoring country risks exposing a nuclear program if it is trying to hide one. Once such a program is exposed, the international community may take measures to deny the sponsoring country a nuclear capability. The risk of losing a capability that may have taken years and millions of dollars to acquire and refine would need to be weighed against the potential benefits of a directed terrorist act.[68] The authors' interpretation of this argument is that while state-sponsored terrorist groups have a greater potential to acquire radiological weapons than those without state sponsorship, these groups may actually be less likely to employ them than a "free agent" organization unencumbered by host nation concerns.

State-Sponsored Will. It is hard to quantify the willingness of state-sponsored actors to use WMD. The only known use of a WMD by a terrorist group was the Aum Shinrikyo cult in Japan and they are categorized as non state-sponsored by US State Department.[69] What is not difficult to determine is that state-sponsored groups are not adverse to mass casualties. The state supported group Abu Nidal organization, also known as "Black September" and a variety of other names, has killed or wounded almost 900 people in attacks across 20 countries.[70] It is difficult to state categorically that state-sponsored groups possess the will to employ radiological weapons. However, there is evidence that some attacks are aimed at causing mass casualties, such as the Libyan-

supported bombing Pan Am Flight 103 in 1988, which cost 270 lives.[71] The terrorists' devotion to their cause can be very strong. This devotion could support a willingness to employ INDs and RDDs.

> Consider, for example, a recent statement by Jamal Abdel Hamid Yussef, explaining operations of the Izzedine al-Qassam Brigades, military wing of Hamas, Gaza: Our suicide operations are a message . . . that our people love death. Our goal is to die for the sake of God, and if we live we want to humiliate Jews and trample on their necks. Combined with access to nuclear weapons, such an orientation to death warrants very close examination.[72]

Non State-Sponsored

Terrorists without identified state sponsorship comprise 60 percent of terrorist groups identified by the US State Department.[73] While terrorism can have both a political and a criminal element that distinction is not critical to this paper.[74]

Ability of Non State-sponsored. In 1995, the Chechen separatist guerrilla leader Shamyl Basayev buried radioactive material in a park in Moscow making good on his threat to conduct attacks on Moscow with nuclear and chemical weapons.[75] *Jane's Intelligence Review* states that the Aum Shinri Kyo sect had the ability to purchase nuclear material to construct a radiological weapon in 1996. At that time the sect had $1 billion (US) in assets and 40,000 members worldwide.[76] The indictment issued in November 1998 against Osama bin Laden accused him of participating in a number of terrorist activities including "attempting to obtain the components of chemical and nuclear weapons."[77] The documented events indicate more than one terrorist organization has or is actively pursing the ability to produce radiological weapons. Is there any evidence they have the will to employ them?

Non State-sponsored Will. The Aum Shinri Kyo sect decided to produce and employ Sarin nerve gas because they could have an operational capability quicker than an IND.[78] The fact that they used chemical instead of nuclear WMD does not change the fact that they had the will to inflict mass casualties.

Summary of Why Nuclear Terrorism is a Threat

In summary, there are four factors that increase the risk of nuclear and radiological terrorism: Firstly, increases in technical data due to the Internet. The Internet has revolutionized the way information is distributed. Potential designers and users of WMD have design information and vital technical data at their fingertips. Secondly, there has been a marked increase in source availability with the demise of Russia. Never before has nuclear and radiological material been more available. Thirdly, security is poor in the FSU: the security workforce has been significantly downsized, the workforce has low morale, and generally uses inadequate procedures. Finally, a trend of increasing terrorism continues, coupled with the fact that terrorism is becoming more lethal. These four factors taken together show that nuclear and radiological terrorism is a threat to US interests. [79]

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Chapter 3

Consequences

NBC terrorism is a low-probability, high-consequence event

- Richard Falkenrath[1]

The March 1995 Tokyo subway incident demonstrated clearly to the world that a WMD attack could be carried out by a terrorist group. Had the Aum Shinrikyo group been more proficient in their delivery method, fatalities could have been in the thousands.[2] Let us look at some of the possible consequences of a radiological terrorist attack on US interests:

First, there could be mass casualties on a scale never before seen in this country. This obviously would be an immediate effect and overtax any response system. If terrorists detonated an IND in a densely populated area, the weapon could easily kill over 100,000 people.[3] An RDD would probably not kill as many people, but given the right design, still has the potential to kill in the tens of thousands if spent nuclear fuel were used or if a nuclear power plant's containment system were successfully breached. A simulation of this event is included in Appendix A. Only wars and plagues have caused casualties on this magnitude before.[4]

Second, there would be contamination. The size of the area would vary depending upon the device used. An IND detonation would render an area uninhabitable for long periods of time, possibly decades. The 1986 breech of the commercial nuclear power

plant at Chernoybl in the Ukraine illustrates this point. Many adjoining areas around it are still uninhabitable almost 13 years later. An RDD on the other hand, would have a more limited impact, both in terms of destruction and environmental impact. In any event a costly clean-up action would be required. At a minimum, a contamination incident would surely affect the lives of many people.[5]

Third, panic would occur. Just the words “nuclear” or “radiological” provoke fear in the US public. At the first report of a radiological incident, the public will likely try to execute an uncontrolled evacuation away from the area. Panic might produce casualties and damage far in excess of the actual device itself.[6]

Fourth, there would be degraded response capabilities. Response personnel in the general area could be affected and if so, would be unable to carry out their assigned tasks. Response personnel would have to be specifically trained to conduct rescue and recovery operations in a potentially contaminated and lethal environment. The Nunn-Lugar-Domenici FY97 defense authorization bill (S 1745) authorized expenditures of up to $80 million for such training.[7] Also roads and avenues of approaches to the stricken area would likely be congested.

Fifth, the economic effects would be substantial. A radiological or nuclear attack would cause major economic damage to the affected area. The attack could possibly affect the nation’s economy either directly or indirectly, especially if the target has economic significance. International financial markets could be affected, possibly triggering a worldwide panic and recession. Certainly the effects of such an attack could run into the billions of dollars.[8]

Sixth, the US could suffer from a loss of strategic position. A radiological attack could cause great damage to US interests either domestically or abroad. The US may be deterred from entering a potential regional crisis for example. Key institutions of military forces themselves could come under attack, damaging force-projection capabilities, or causing the US military to withdrawal from a given area or deployment. This could seriously affect US foreign policy efforts.[9]

Finally, a radiological attack could cause psychological damage and political change. Mass casualty attacks have a profound affect on a nation. Public terror in the aftermath of a radiological attack would probably be intense. Powerful conflicting forces such as paranoia, isolationism and vengeful fury would struggle for control of foreign policy. On the domestic scene, the failure to prevent a radiological attack could cause the population to lose faith in its government, possibly creating a shift in power, as the public demands that more preventative actions be taken. Ultimately the response could lead to a curtailing of civil liberties that form the basis of democracy.[10]

This preceding discussion of potential consequences has been largely theoretical up to this point, but what of the practicalities? Have there been any actual reported instances of nuclear or radiological attacks? Thankfully there has not yet been a single incident of a successful IND attack, however, as pointed out earlier the potential is at an all-time high. But what of attacks with RDDs, have there been instances of their use?

In perhaps the most widely reported radiological terrorist incident, a Chechen guerrilla leader named Shamyl Basayev, told a Russian television network on 23 November 1995 that four cases of radioactive cesium had been hidden around Moscow. The network found a 32-kilogram box in Ismailovo Park, Moscow. The box contained

radioactive material sources. Although these sources were not likely to cause any radiation-induced fatalities, they did accomplish their goal of bringing worldwide media attention on the event itself as well as the Chechen struggle. Since Basayev had threatened to attack Moscow with nuclear and chemical weapons, he staged this event to demonstrate both ability and intent. The threat was plausible, since the state of the Russian Nuclear industry, as described earlier, made it impossible to rule out the Chechens access to weapons grade nuclear materials.[11]

In another more isolated incident, the Russian mafia planted radioactive sources in a Moscow businessman's office, effectively giving him a lethal dose over a short period of time.[12] What countermeasures are available against radiological and nuclear terrorism attacks?

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Chapter 4

Countermeasures

Historical Responses to the Three Actors

> *The proliferation of weapons of mass destruction continues to pose an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States*
>
> -President William Clinton[1]

The President declared a national state of emergency in 1994 when he issued Executive Order (EO) 12938, which asserted that the proliferation of weapons of mass destruction posed an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States.[2] That declaration has been reviewed and extended on an annual basis every year since 1994. This EO focuses the energy of the US government on defending against an urgent threat; in itself a form of response.

According to FBI testimony the US fights terrorism using diplomacy, sanctions, covert operations, military operations and law enforcement actions.[3] That list captures all the activities uncovered in a brief review of past US responses to terrorism. A complete discussion of countermeasures must include a review of US responses to the threat as well as some measure of the relative effectiveness of those responses.

Response to State Actors

Since we have no experience with a state actor employing radiological weapons against us predicting our response is problematic. In response to India's nuclear detonations in May of 1998, President Clinton quickly enacted economic sanctions.[4] While an Indian nuclear weapon program is probably not a prelude to a nuclear attack on the US, it is a clear demonstration of WMD proliferation and one of the items identified in EO 12938. If radiological weapons were used against US personnel, the response would doubtless be more direct. The Gulf War experience indicates that the demonstrated ability to hold the leadership of a state actor at risk may be an effective strategy for preventing their use of WMD, and nuclear weapons in particular, in a war. However, the Gulf War does not answer the question as to what would prevent a state actor for employing those weapons indirectly through a terrorist act.

Response to State-Sponsored Terrorists

For state-sponsored terrorism the states' decision to supply material and expertise should be part of their national security policy calculus. If this is the case, the same strategy of holding the aggressor nation's leadership at risk may be an effective method for reducing that country's support of terrorism in general, which should, in turn, decrease the potential for radiological terrorism. The 1986 El Dorado Canyon attack by US military aircraft was an effort to reduce Libyan sponsored terrorism. Targets included a government command center, terrorist training facilities and the Tripoli airport.[5] However, this attack and ongoing sanctions did not stop Libyan support of terrorist attacks against airliners in 1988 and 1989 which killed a total of 440 people.[6]

Perhaps due to frustration with the indecisive results of direct attacks against terrorist facilities and their sponsoring states, US policy appears to be changing. The President's coordinator for counterterrorism said "we may not just go in a strike against a terrorist facility; we may choose to retaliate against the facilities of the host country, if that host country is a knowing, cooperative sanctuary."[7] This policy may see attacks against sponsoring country infrastructure (vice a single command and control node as in El Dorado Canyon) in an attempt to pressure those states to cease their support of terrorism. While this policy may affect the approximately 30 percent of terrorist organizations who are state supported, it leaves the majority of terrorist organizations untouched.

Response to Non State-Sponsored Terrorist

Non state-sponsored actors may possess a center of gravity that defies targeting by the majority of the methods mentioned earlier (diplomacy, sanctions, covert operations, military operations and law enforcement actions). Additionally, while non state-sponsored groups do not directly benefit from a state's support they also operate without the moral and legal restraints of a state's government. US response has so far been to increase defensive measures including cooperation with friendly governments in the law enforcement arena. While it possible that the US has conducted covert operations against non state-sponsored terrorists these operations would, by definition, not show up in a review of unclassified material on this subject.

Assessment

Each of the three potential employers of radiological weapons, states, state-sponsored terrorist and non state-sponsored terrorists appear to have, or be actively pursing an IND or RDD capability and some have employed WMD. Those same entities

have all demonstrated a willingness to inflict mass casualties in pursuit of their cause. However, not everyone who studies terrorists believes they will use INDs specifically. A recently released book by a former RAND researcher and international terrorism expert, Jeffery Epstein, explains that nuclear terrorism, while possible, is unlikely because conventional bombs can cause destruction such as that seen in Oklahoma City and the World Trade Center without the additional investment required to make a nuclear weapon.[8]

A counter to that contention is Alexander Lebed's claim that a number of KGB-acquired nuclear suitcase bombs were unaccounted for which means that there may be ready-made, easily portable, nuclear devices available to hostile actors.[9]

Potential Responses to Radiological Terrorists

> *I applaud CSIS [Center for Strategic and International Studies], the Global Organized Crime Project leadership, and the Nuclear Black Market Task Force for taking the initiative in setting up a structured environment, in the form of the Wild Atom simulation, to provide a mechanism for addressing the tough public policy issues related to weapons of mass destruction terrorism. I join the authors of this report in hoping that others will use the experience of Wild Atom to raise awareness about these difficult problems. I also share their hope that the Wild Atom will serve as a model for simulation of other types of weapons of mass destruction attacks against the United States.*
>
> —Sam Nunn, former US Senator (D-GA)[10]

What additional actions could this nation take to reduce the threat posed by radiological weapons? The Center for Strategic and International Studies' Global Organized Crime Project, in conjunction with the National Defense University, conducted a terrorist nuclear attack simulation/wargame called Wild Atom in November 1996. The project was led by William Webster, former head of the CIA and the FBI.

The steering committee included four former heads of the CIA. The 70 participants and steering committee produced some key findings.[11] These focused on three areas, of which two, Intelligence, and Policy and International Cooperation, were preventive, and one, Incident Management (consequence management) was reactive.[12] Preventative measures, or crisis management as the FBI calls it, deal with preventing an incident from occurring. Preventative measures can be thought of in four broad areas: improving intelligence efforts, improving detection technology, utilizing the diplomatic instrument of power and utilizing the economic instrument of power. Each of these four areas will be explored in detail.

Prevention

Intelligence

> *In one known case at least, the swift FBI deployment after the World Trade Center bombing and its infiltration of the group involved, foiled a much greater plan to bomb the United Nations building and the Lincoln tunnel in New York.*
>
> -Ely Karmon[13]

The Wild Atom participants recommended exercises and training to improve relationships between intelligence analysts, officials and law enforcement agencies. Increased international intelligence sharing efforts to more aggressively profile and track potential criminal, terrorist and rogue state proliferation activities. Finally, the participants urged that the intelligence community invest more money and time in developing detection systems that can detect the tell-tale radioisotopes from a greater distance and at much lower levels than currently feasible.[14] Obviously such an improvement would necessitate technological advances.

Technology

One of the major technological problems is detecting radioactive and nuclear materials. Nuclear source materials are primarily alpha particle emitters and are inherently difficult to detect. Alpha particles have limited range in air, and can be stopped by materials as thin as a piece of paper. Simple and inexpensive shielding can defeat most sensors, and render these materials undetectable.[15] There are a few new developments on the horizon, however, that may help detect the threat.

John Nuckolls, the former director of the Department of Energy's (DoE) Lawrence Livermore National Laboratory, told Congress that Livermore researchers have been working on a new "color" gamma camera that could detect weapons at ten times the distance now possible. The problem is that this new technology requires an exception be made to the Comprehensive Test Ban Treaty. If such an exception were not politically possible then the gamma camera would remain strictly theoretical with no way to test it.[16] In another Livermore development, a system called the Wide-Area Tracking System (WATS) is being tested at a military base. The WATS is an advanced data-fusion algorithm, consisting of commercial radiation detectors, vehicle detectors and communications. The WATS is designed to detect and track in real time the movement of radioactive sources in an area as small as an airport or as large as a city.[17]

In yet another DoE initiative, scientists at Los Alamos have demonstrated a sensor system called CALIOPE (for Chemical Analysis by Laser Interrogation of Proliferation Effluents). The technology is multipurpose; it can possibly detect nuclear materials as well as chemical signatures associated with chemical weapons. So indirectly it is possible that nuclear production facilities could be detected with this technology, by detecting unique chemical signatures, associated with nuclear production facilities.

Because a variety of materials can be used in nuclear and radiological weapons, the type and quantity of radiation signatures vary widely. Additionally, the detectability of radiation from such materials declines rapidly with distance. Therefore radiation sensors are likely to be ineffective as early warning devices if they are farther than some tens of feet from the suspected materials.[18]

In a more managerial than technical way, the US nuclear industry can help out by bringing Russia up to international standards. For instance, Russia needs a baseline inventory of nuclear materials.[19]

Diplomatic Efforts

In the policy arena the Wild Atom group recommended that national agencies follow a consistent strategy and that security organs share foreign-derived information with domestic organizations that would benefit from it. Another recommended policy improvement is for US policymakers to train and exercise response procedures before an actual crisis. Finally under the rubric of policy, the group recommends a "you-will-die-if-you-try" posture towards nuclear terrorists. This posture would combine elements of defense, deterrence and response. Should a terrorist device (presumably nuclear) come to the US, the country should take a defensive stance by closing the borders temporarily and increasing detection efforts offshore. Next, the US should attempt to deter further nuclear terrorism by announcing a national policy of taking preemptive action against any entity having non-safeguarded nuclear material if these entities refuse to relinquish the material. This action would correspond with increased rewards for turning in fissile materials and information on nuclear traffickers. Finally, the US should adopt a policy

response announcing the relentless pursuit of nuclear/radiological terrorists and the elimination of these entities if they cause a nuclear or radiological explosion.[20]

Supporting international cooperation, the Wild Atom participants recommended the promotion of multilateral conventions on weapons and weapons-grade material, and additional aid for emphasis on Russian nuclear material security. In addition the participants recommended a "public diplomacy campaign to identify nuclear terrorists as international outlaws…and bounties and amnesty for help in neutralizing nuclear criminals."[21] Ironically, the project participants acknowledge that the lack of any confirmed smuggling of illegal material in recent years has produced "overconfidence" in some US government circles.[22] US economic assistance efforts should leverage international organizations such as theUnited Nations (UN), the Organization for Security and Cooperation in Europe (OSCE) and even the North Atlantic Treaty Organization (NATO).

Economic Assistance

Closely related to diplomatic efforts, the United States can use its economic power to assist Russia. One of the steps the US can take is to purchase nuclear material from Russia and increase expenditures to stop smuggling and bolster anti-terrorist efforts.[23] If the US does not act, some other country might. In fact, Russia's Ministry of Atomic energy was accused of trying to sell HEU for hard currency to Iran. But the US has acted, tentatively agreeing to purchase 500 metric tons of HEU over a 20-year period at a cost of $12 billion (US). Russia would dilute the HEU to commercial power plant strength, making it much harder for a potential weapon developer to reconstitute it into appropriate nuclear weapon material. Originally, DOE conducted the program. In 1992,

however, Congress directed DOE to transfer its commercial grade uranium production activities to a semi-governmental corporation, the United States Enrichment Corporation (USEC). USEC inherited a "swords-to-ploughshares" effort, but the transfer of responsibility allowed a shift in focus to producing a profit. USEC tried to take advantage Russia in the agreement, delaying transfers of fissile material and processing from unsafe storage sites. Was USEC putting profits ahead of national security? The US needs to press on with this deal and buy as much Russian nuclear material as it can.[24]

Consequence Management Actions

By taking an analogy from our National Military Strategy "the primary purpose of US Armed Forces is to defeat such threats should deterrence fail,"[25] we must be prepared to deal with an incident if we are unable to prevent it. Consequence Management, in terms of response to WMD attacks, has gotten a lot of attention in the past few years. One need only look at the federal funding. Vernon Loeb reports in his *Washington Post* article:

> Probably no single provision in the supplemental appropriation illustrates the government's rapidly growing commitment to counterterrorism than a domestic preparedness grant program run by the Justice Department for training and equipping local fire departments to respond to terrorist attacks. Two years ago, the program did not exist. Last year, $12 million was appropriated. This year, it is $135 million. And next year? The budget released yesterday includes $171 million, an increase of almost 27 percent.[26]

Wild Atom participants urgently recommended that Consequence Management be addressed.[27]

Major Players

The Department of Defense is becoming a major player in the Consequence Management game. In April 1996 the Marine Corps stood up the Chemical and Biological Incident Response Force, consisting of approximately 350 troops, who would respond to a terrorist incident involving chemical or biological WMDs.[28] Recently, Secretary of Defense William Cohen asked for presidential approval for a permanent task force, to be headed by a general officer, to coordinate the military's response to a chemical or biological attack on the US. Most likely the task force would be subordinate to the US Atlantic Command, the geographic CINC recently tasked with the training charter. The goal is to provide a more systematic and coordinated approach to the problem. This supplements a plan set into effect last year which created 10 rapid-response Guard teams, each with a geographic area of responsibility and with the mission of responding to the scene of a chemical or biological attack.[29]

Most curious in the description of these teams is the absence of the words "radiological" or "nuclear." Within the DoD community the Army, Air Force and the Navy each have a team dedicated to radiological incident response. The Navy maintains its RADCON (Radiation Control) team in Norfolk, Virginia, however, the team is a fixed, dedicated asset supporting the Navy nuclear submarine program. The Army maintains its RADCON team based at Fort Monmouth, New Jersey. The team consists of approximately 14 personnel, enough to operate their mobile, isoshelter mounted radioanalytical laboratory, and employ a field team capable of conducting limited radiological detection. The Air Force maintains the AFRAT (Air Force Radiation Assessment Team) based at Brooks AFB, Texas. The team currently has approximately 40 personnel, has a radioanalytical laboratory in an air-transportable trailer, and can

employ four three-man teams simultaneously, each capable of conducting radiological detection operations.

> The AFRAT provides commanders with viable solutions to operational obstacles imposed by the presence of radioactive materials or radiation hazards. The team can provide complete threat identification and assessment, site characterization, and consultation for mitigation, force protection, and remediation activities. The AFRAT has expertise in depleted-uranium weapons, tactical nuclear weapons and the tactical environment, releases of radioactivity from nuclear facilities, bioeffects of ionizing radiation, and toxicological effects of radioactive materials [30]

The Department of Energy has a fairly robust capability for consequence management actions involving radiological incidents. The following is a brief summary of DoE radiological Consequence Management assets:

> ARG, the Accident Response Group, will respond at a moment's notice to any nuclear or "radiological" accident, including, for instance earthquake damage to a nuclear power plant. ARG is funded at $ 11 million a year and is staffed by some 500 volunteers at the national laboratories.
>
> ARAC, the Atmospheric Release Advisory Capability, will take weather, aerial, mapping, and radioactive source material data concerning a nuclear incident or accident and produce three-dimensional models of downwind contamination for use by emergency preparedness personnel. The budget is $7 million for a full-time staff of 25.
>
> AMS, the Aerial Measuring System, operates several fixed-wing and rotary aircraft that can fly through radioactive plumes and do radiological characterization, which can be crucial in the first few hours of a nuclear reactor accident. The aircraft can also analyze nuclear signatures on the ground from lost or stolen nuclear material. The operating cost is $7 million per year.
>
> FRMAC, the Federal Radiological Monitoring and Assessment Center, was created after the Three Mile Island incident. It is responsible for all off-site radiological monitoring and assessment and for providing consistent information to all authorities involved. The budget is $1 million.
>
> NEST, the Nuclear Emergency Search Team, is staffed predominantly by volunteers from the nuclear weapons programs. NEST provides domestic or international response to active nuclear terrorism or malevolent nuclear threats. NEST personnel provide technical expertise and work with

> Defense Department personnel who provide what's known in the business as explosive ordinance disposal. The NEST budget is $35 million per year. [31]

NEST members have responded to 30 incidents, which have all been hoaxes so far, since 1975. Problems encountered are naturally occurring radioactive materials and limited utility of the AMS in urban areas.[32]

> RAP, the Radiological Assistance Program, is split between eight regional offices and is the first line of response to a potential nuclear accident. RAP personnel can be on-site anywhere in the country within an hour or two, when it might take NEST personnel, for instance, 5 or 6 hours to fly in from Albuquerque, New Mexico. Budget $2.5 million.
>
> REAC/TS, the Radiation Emergency Assistance Center/Training Site, is one of two World Health Organizations (WHO) that train emergency-room physicians and medical personnel to provide triage in case of a radiation accident and to recognize exposure to ionizing radiation when they see it. The budget is $800,000 per year.[33]

Recent developments within the DoE show cause for concern. Almost 95% of the NEST team members are volunteers. Budgets are declining, and the government is putting more emphasis on chemical and biological WMDs. There are dwindling response capabilities to countering nuclear terrorism, and the DoE has received no funding to support counterproliferation. A Lawrence Livermore National Administrator who wished to remain anonymous describes the situation like this: "So what we're doing is focusing on one hole in the dike, and ignoring the fact that there can be other holes."[34]

The Federal Emergency Management Agency (FEMA) is the lead federal agency in any consequence-management action within the continental United States.[35] FEMA serves mainly as a command and control infrastructure for the response effort, coordinating the response of the many agencies that would respond to an incident. If the US were to respond to an incident overseas, the State Department would be the lead Federal Agency.[36]

Needed Actions

While many agencies have radiological and nuclear response capabilities, what is needed is an effective integration of these assets. The United Nation's International Atomic Energy Agency (IAEA) is a possible umbrella organization for this integration. This opinion is supported by John Nuckolls, associate director at the DoE's Livermore Lab, "The international community should develop a flying anti-nuke squad."[37] This integration of assets should be exercised in a series of drills utilizing radiological and or nuclear response scenarios.

The DoE and DoD host a major nuclear weapon accident response field exercise every two years, the last being Digit Pace in May,1997, however, the scenario always involves an accident with nuclear weapons, simulating a release of radioactive materials from a nuclear weapon. Having a fixed scenario like this also allows the exercise participants to have a pretty good idea of the events and actions required. Even with this generally fixed scenario, however, from Major Nichelson's personal experience at this exercise, the integration of the various response teams needed much improvement. For example, it was frustrating not knowing all the various players on the team, and what their capabilities were. A good analogy would be Desert One, the failed Iranian hostage rescue attempt in 1979. One of the reasons the attempt failed was that the services which executed the plan had not practiced together or become familiar with each other's capabilities and limitations. Thus a lack of "jointness" exists in the consequence management world. In summary, more exercises are needed within the DoE and DoD communities, along with local initial response teams, focusing on a wide variety of potential radiological consequence management actions. In addition, the possibility exists that a radiological/nuclear terrorism incident could take place against a vital US

interest, such as a large concentration of US forces outside the continental United States, and plans should also be established and exercised to deal with that contingency. A concrete example of this within the US armed forces would be to add, and exercise, a specific annex to Operation Plans (OPLANS) to address these potential incidents.

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Chapter 5

Conclusion and Summary

Is there a credible threat to US interests from a radiological weapon of terror? The short answer is yes. In summary, there are four main factors that increase the risk of nuclear and radiological terrorism to US vital interests: First, technical knowledge is more readily available due to the Internet. The Internet has revolutionized the way information is distributed, bringing instant access to design information for potential WMD manufacturers. Second, there has been a marked increase in source availability with the economic collapse of Russia. Never before in history has the potential for nuclear and radiological material been more available. Third, security procedures in Russia are extremely lax, employing demoralized workers and utilizing grossly inadequate procedures. Finally, despite a decrease in the overall number of terrorist incidents, these attacks are becoming more lethal. Terrorist groups have the means, the financial backing, and the will to use weapons of mass destruction. These four factors taken together strongly suggest that it is only a matter of time before a nuclear or a radiological terrorist attack is levied against a vital US interest.

What can be done? The United States must continue utilizing all its instruments of power in an attempt to avoid a crisis. Politically, the US can support Russia, bringing expertise to help with standardizing procedures to international norms, and appropriate

accounting of all radiological and nuclear materials. Economically, the US can support Russia by buying excess nuclear material and granting or loaning funds to Russia to upgrade infrastructure, personnel funding requirements, and anti-terrorist training. Militarily, we can help by conducting military-to-military exchanges, and demonstrating our response capabilities, including a multi-national response exercise.

If deterrence efforts fail, then the nation must plan for a response to a radiological or a nuclear attack. Exercises must be conducted and training must be accomplished. The military is the ideal agency for this mission since it has the organic command and control assets to deal with a Consequence Management situation and can be deployed. Ideally, a standing federal task force consisting of FEMA, DoE, and DoD personnel could be established to conduct consequence management actions that could respond to any CONUS situation. Also the State Department should be involved in the event that an incident takes place overseas. This event could be either a direct attack against US assets and personnel, or a foreign government could ask for US Consequence Management assistance. From the DoD perspective, a comprehensive radiological and nuclear Consequence Management response team is needed. CBIRF has the manning and organic infrastructure to support such a team, but does not have the technical expertise in the discipline of radiation protection. Ideally CBIRF should meld with an organization like AFRAT, to form a true joint radiological response task force. The bottom line is the US must make preparations now for the imminent radiological attack. For it is not a question of if it will occur, rather a question of when it will occur.

Annex A

Simulated RDD attack at Langley AFB, VA

Notional RDD Scenario

The date is 1 March 1999. A terrorist group is planning to use an RDD attack against Langley AFB, VA. The terrorists have stolen a spent fuel rod from nearby North Anna nuclear power plant. They gain access to the base using a stolen identification card, and are driving a rental truck full of two tons of fertilizer and diesel fuel, and have packed the spent fuel rod in the middle of the explosive mixture. They park in the wing headquarters parking lot, exit the base using a previously placed getaway vehicle, and set the bomb to explode at high noon.

Hazard Prediction Assessment Code (HPAC) Simulation Software Overview

> HPAC is a forward deployable, counter-proliferation/counter-force capability available for government, government-related or academic use. This software tool assists warfighters in weaponeering targets containing weapons of mass destruction (WMD) and in emergency response to hazardous agent releases. Its fast-running, physics-based algorithms enable users to model and predict hazard areas and human collateral effects in minutes.
>
> HPAC provides the capability to accurately predict the effects of hazardous material releases into the atmosphere and its impact on civilian and military populations. The software uses integrated source terms, high-

resolution weather forecasts and particulate transport to model hazard areas produced by battlefield or terrorist weapons of mass destruction (WMD) use, conventional counterforce attacks against WMD facilities, or military and industrial accidents. One of HPAC's strengths is fast access to real-time weather data via Meteorological Data Servers (MDS). HPAC also has embedded climatology or historical weather for use when real weather is not available.

HPAC models all nuclear, biological, and chemical (NBC) collateral effects of concern to military operations. These may derive from the use of NBC weapons or from conventional weapon strikes against production and storage facilities for such weapons. Similar effects may result from military or industrial accidents. HPAC provides source information on potential radioactive releases from nuclear weapons or reactor accidents and has the capability to generate source terms for nuclear, chemical and biological weapon strikes or accidental releases.

HPAC includes the SCIPUFF model for turbulent transport, a new and advanced technology that provides a highly efficient and accurate prediction for a wide range of hazard scenarios. HPAC can also help answer the question -- "How good is the prediction?" -- providing probabilistic solutions to the atmospheric transport problem. HPAC or MEA builds source terms for hazardous incidents for input to the atmospheric transport model, SCIPUFF. The current code hosts operator-friendly "incident" setup capability for nuclear, biological, and chemical releases resulting from either weapon deployment or facility attack. Sample HPAC projects are provided which may be edited to suit a wide range of user requirements or incidents. Additional improvements in the software are planned, but user feedback will ensure that these improvements include a user's perspective, not just a scientist's.[1]

Assumptions and Data

The following assumptions and data were used and/or entered as variables into the HPAC simulation software:

- 1 spent fuel rod (mass = 10.72 kg) from the North Anna power plant (reactor power = 2893 megawatts)
- 4000 pounds of High Explosives

- Altitude of incident: ground level
- Location of incident Langley AFB, VA
- Time of incident: March 1, 1999 at 12:00 noon (local time)
- HPAC software utilized historical weather data for temperature and winds
- The simulation was terminated after an estimated 12 hours after the scenario, due to the operator's opinion that further radiological dispersion was negligible.[2]

Simulation Outputs

The following plots show potential radioactive material dispersion patterns and give an estimate of the total radiation dosage in rems that a person would receive if they remained on the surface with no protection for the entire time period given.[3] An acute whole body dose of 450-500 rems would cause approximately 50% of people to die within 30 days.[4]

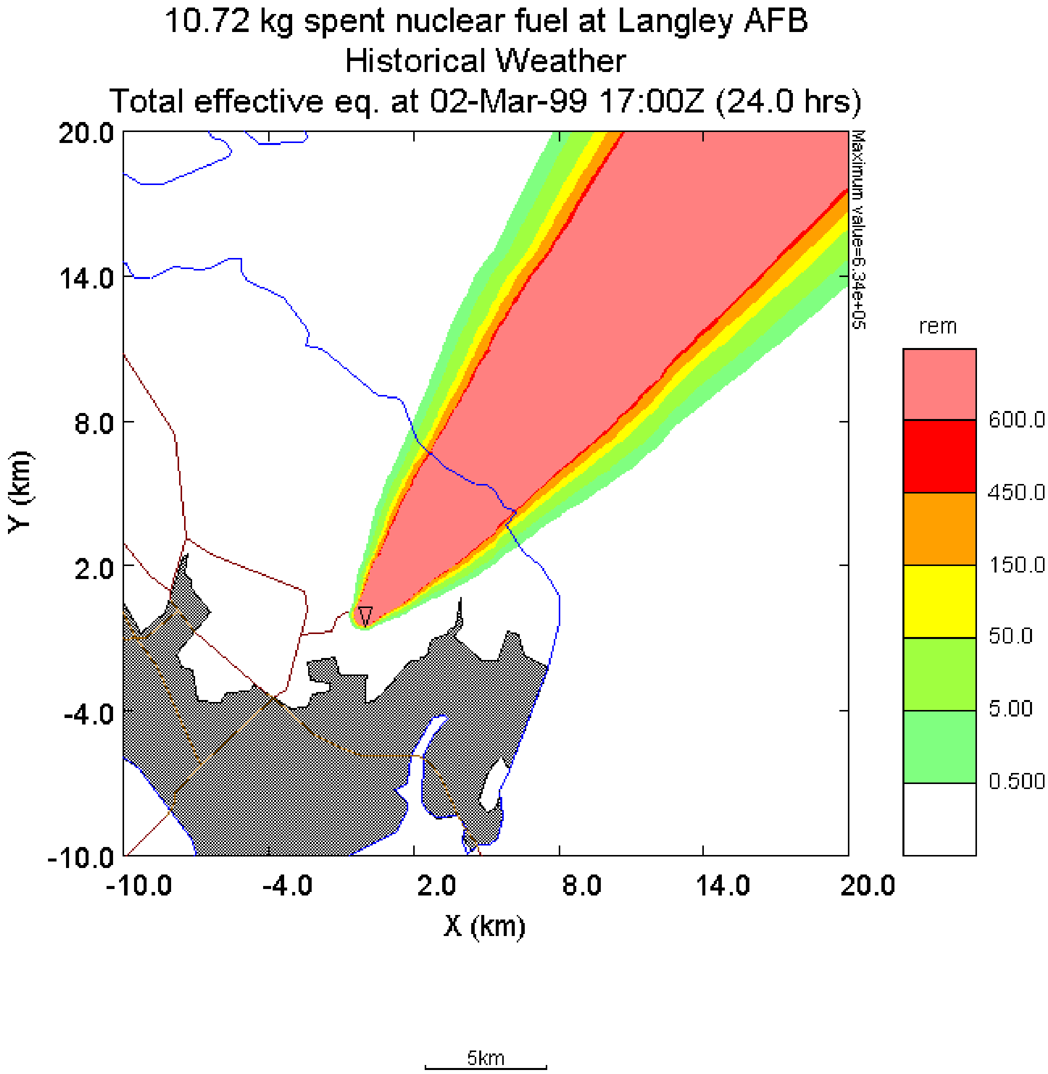

Figure 1 RDD Local Effects

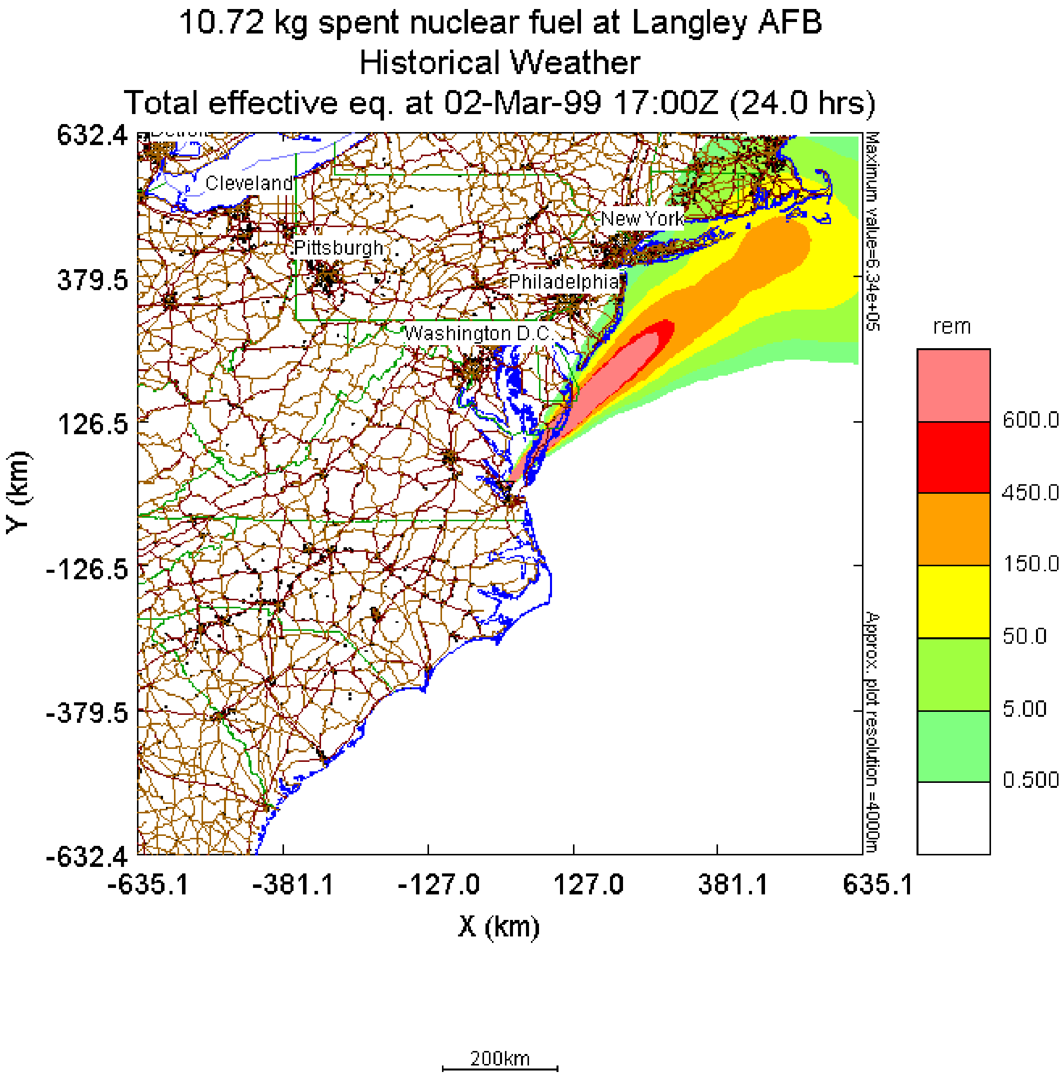

Figure 2 RDD Regional Effects

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Glossary

AFRAT	Air Force Radiation Assessment Team
AMS	Aerial Measuring System
ARAC	Atmospheric Release Advisory Capability
ARG	Accident Response Group
CALIOPE	Chemical Analysis by Laser Interrogation of Proliferation Effluents
CBIRF	Chemical and Biological Incident Response Force
DoD	Department of Defense
DoE	Department of Energy
EOD	Explosive Ordinance Disposal
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FRMAC	Federal Radiological Monitoring and Assessment Center
FSU	Former Soviet Union
HPAC	Hazard Prediction Assessment Code
HEU	Highly Enriched Uranium
IAEA	International Atomic Energy Agency
IND	Improvised nuclear device
NBC	Nuclear (Radiological), Biological or Chemical
NEST	Nuclear Emergency Search Team
PDD	Presidential Decision Directive
PSYOPS	Psychological Operations
Pu	Plutonium
RAP	Radiological Assistance Program
RADCON	Radiation control
RDD	Radiological dispersion device
RDW	Radiological dispersion weapon
REAC/TS	Radiation Emergency Assistance Center/Training Site
START	Strategic Arms Reduction Treaty
TNT	Trinitrotoluene
U	Uranium
USAF	United States Air Force
WATS	Wide-Area Tracking System
WMD	Weapons of Mass Destruction

Consequence Management: Measures to protect public health and safety, restore essential government services, and provide relief to

governments, businesses and individuals affected by the consequences of terrorism.

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